Life in Coastal Sage Scrub: Ecology of Cabrillo NM

Teacher Packet

Program: A third through sixth grade program about plants, animals and their interactions in coastal sage scrub habitat.
Capacity: Thirty-five students. One adult per five students.
Time: One hour. 9:45a.m.-10:45a.m. or 11:00a.m.-12:00p.m.
Meeting Locations:

9:45 a.m. – Meet at the planter in front of the administration building.
11:00 a.m. – Meet at the road leading down to the Bayside Trail. The ranger in the visitor center will provide directions to the proper location.

Park Theme to be Interpreted: Coastal sage scrub is a unique and disappearing habitat type in southern California, but is still beautifully preserved at Cabrillo National Monument. The plants and animals that live in coastal sage scrub exist in relationship with each other and their environment, and deserve our understanding and protection.

Objectives: At the completion of this program, students will be able to:

1. Describe a food web.
2. Identify several native plants and animals that live in coastal sage scrub habitat.
3. Understand the following terms: organism, native, non-native, food web, and decomposer.
4. Explain why it is important to preserve coastal sage scrub habitat.

California Science Content Standards Grades K-12

Grade 3:

3a. Students know plants and animals have structures that serve different functions in growth, survival and reproduction.
3b. Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands and wetlands.

Grade 4:

2a. Students know plants are the primary source of matter and energy entering most food chains.
2b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.
2c. Students know decomposers, including many fungi, insects and microorganisms, recycle matter from dead plants and animals.
3a. Students know ecosystems can be characterized by their living and nonliving components.
3b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
3c. Students know many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.

3d. Students know that most microorganisms do not cause disease and that many are beneficial.

Grade 6:
5a. Students know energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.
5b. Students know matter is transformed over time from one organism to others in the food web and between organisms and the physical environment.
5c. Students know populations of organisms can be categorized by the functions they serve in an ecosystem.

Introduction:
Coastal sage scrub is a dominant plant community at Cabrillo National Monument. Similar plants are found from Santa Barbara, California, south to Ensenada, Baja California. Coastal sage scrub vegetation is composed of annuals that provide seasonal color and ground cover, and perennials that are classed as shrubs. Coastal sage scrub plants seldom reach over 12 feet in height. They typically grow in areas with less than 10 inches of rainfall per year and areas that do not freeze. In many places, this amount of rain would indicate a desert environment, but coastal fog plays a big role in keeping the humidity high enough for these relatively supple plants to grow, and creates what is commonly called a Mediterranean climate. Other Mediterranean climates are found around the Mediterranean Sea, Chile, South Africa and southwestern Australia. In California, coastal sage scrub plants and other organisms that live in this habitat must compete with human needs for land.

Scientists have studied many organisms in coastal sage scrub habitat over the past 10-15 years, including large carnivores, intermediate-sized mammals (i.e. skunks, raccoons), ants, other arthropods, lizards, snakes, amphibians, birds, small mammals and vegetation. Cabrillo National Monument has good species records for all of the plants, mammals, birds, reptiles, amphibians, ants, and some other insects and spiders found here. All of the organisms at Cabrillo NationalMonument, from the largest coyote to the microscopic fungi, have relationships with each other and their environment. These relationships can be characterized through food chains. A food chain is an energy pathway that usually starts with a producer (plant), goes through one or more consumers (animals) and ends with a decomposer (animal, fungi, bacteria, insect). Many food chains can be linked together to create one large food web for a particular habitat. Food webs are often difficult to characterize, particularly since many macro- and microscopic organisms are still undiscovered and unnamed, and the basic life history of many animals is not known.

In this program, students first take a nature walk through coastal sage scrub, observing and learning about the organisms that live there. On the walk, students are introduced to the following concepts: organism, native, non-native, food web, and decomposer. If time permits, students learn as many as ten local plants, animals and fungi. Next, the ranger leads the students in a group activity of building a food web with the organisms they just learned about, emphasizing the roles of producers, consumers and decomposers. To wrap

up the program, the ranger discusses with the students the importance of protecting organisms, and the consequences of extinction due to human causes. Students will take away from this program a deeper understanding and appreciation of the natural world around them, and the importance of conservation and good stewardship toward the natural lands in San Diego.

Vocabulary to teach prior to your visit to Cabrillo National Monument:

- **Producer**: a plant. Plants produce their own food energy using sunlight, water, carbon dioxide, and nutrient from the soil.
    - **pro·duc·er** *n.* A photosynthetic green plant or chemosynthetic bacterium, constituting the first trophic level in a food chain; an autotrophic organism. Source: *The American Heritage® Stedman's Medical Dictionary Copyright © 2002, 2001, 1995 by Houghton Mifflin Company. Published by Houghton Mifflin Company.*
- **Consumer**: an animal. Animals obtain energy by eating (consuming) plants or other animals. Some animals eat both plants and animals.
    - **con·sum·er** *n.* A heterotrophic organism that ingests other organisms or organic matter in a food chain. Source: *The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company. Published by Houghton Mifflin Company. All rights reserved.*

- **Decomposer**: an animal, fungi, bacteria, or insect. These organisms eat dead plants or animals, breaking them down into soil.
    - **de·com·pos·er** *n.* An organism, often a bacterium or fungus, that feeds on and breaks down dead plant or animal matter, thus making organic nutrients available to the ecosystem. Source: *The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company. Published by Houghton Mifflin Company. All rights reserved.*
- **Deciduous**
- **Evergreen**
- **Herbivore**
- **Carnivore**
- **Omnivore**
- **Adaptation**

Vocabulary which will be taught by the ranger during your field trip:

- **Organism**
- **Native organism**
- **Non-native organism**
- **Food web**
- **Decomposer (review)**

Organism Descriptions Used in the Ranger Program

Common name: Lichens - (producer)
Scientific names: (from top left, clockwise) *Caloplaca bolacina, Xanthoparmelia mexicana, Buellia oidalea, Niebla homalea*
Fun facts: Lichen is a combination of fungi and algae. The algae produce food through photosynthesis. Lichens can grow almost anywhere, such as on bare rock, sand, animal bones, dead wood, trees and soil. Lichens can be very flat, or stick up like leaves and branches of plants. Deer and other animals will eat lichens, and many birds use lichens to make their nests. Native Indians also used lichens for medicine and as dye to add color to their clothes.

Common name: California sagebrush - (producer)
Scientific name: *Artemisia californica*
Fun facts: California sagebrush is a shrub that provides homes for many insects, spiders and other arthropods. It is **drought-deciduous**, which means it looses its leaves during dry summer weather. It has a strong scent and produces tiny flowers from summer to late fall. Native California Indians used California sagebrush as medicine, and would chew on the leaves if they had a cold, cough or toothache.

Common name: California ground squirrel - (consumer)
Scientific name: *Spermophilus beecheyi*
Diet: green grasses, leaves, seeds, grains, nuts, sometimes insects and bird eggs
Fun facts: California ground squirrels are primarily **herbivores**, which means they eat mostly plants. They live in burrows, which are systems of tunnels and rooms underground. Often there is more than one opening to a burrow, and many squirrels live together. California ground squirrels use their burrows to store food, sleep, escape danger and raise their young.

Common name: California towhee - (consumer)
Scientific name: *Pipilo crissalis*
Diet: insects, seeds, fruit
Fun facts: California towhees scratch the ground using both feet at once to find their food. This behavior is an **adaptation** because it helps the towhees survive better in their environment.

Common name: California trapdoor spider - (consumer)
Scientific name: *Bothriocyrtum californicum*
Diet: insects
Fun facts: Trapdoor spiders get their name because they dig burrows to live in, and close them off at the top with a hinged lid made of silk, like a trap door. A local **scientist** (Dr. Marshal Hedin, SDSU) is studying a unique trapdoor spider that is endemic, which means it is found nowhere else in the world.

Common name: Lemonadeberry - (producer)
Scientific name: *Rhus integrifolia*
Fun facts: Lemonadeberry has white or pink flowers that bloom in spring, followed by red berries. It is an **evergreen**, which means the green leaves stay on the plant all year long. Lemonadeberry provides food and shelter for many organisms. The native Kumeyaay Indians who lived throughout this area also used the berries by crushing them in water to make a drink.

Common name: Western fence lizard - (consumer)
Scientific name: *Sceloporus occidentalis*
Diet: insects, spiders, other arthropods
Fun facts: Western fence lizards are sometimes called "blue bellies" because adult males have bright blue patches on the underneath side of their bellies and chins. Western fence lizards will drop their tails if they are caught as a **defense**. The old tail will keep wiggling to distract the predator while the lizard escapes. A new tail will slowly grow back on the lizard.

Common name: Red-tailed hawk - (consumer)
Scientific name: *Buteo jamaicensis*
Diet: mostly small mammals (mice, voles, shrews), some times reptiles (lizards, snakes), birds
Fun facts: The red-tailed hawk is a **carnivore** (meat eater) and belongs to a group of birds called raptors (birds of prey). A red-tailed hawk's eyesight is 8 times more powerful than a human's, and its main weapons are its talons, the long, curved, sharp claws on its feet.

Common name: Darkling beetle - (decomposer)
Scientific name: *Eleodes spp*.
Diet: decaying vegetation (dead leaves, rotting wood),
Fun facts: To defend themselves, darkling beetles lower their heads, stick their rear ends into the air and release a foul-smelling black liquid. This **defense** behavior gives the darkling beetle the nickname "stink beetle".

Common name: Green bottle fly – (consumer)
Scientific name: *Phaenicia sericata*
Diet: Larvae (maggots) eat dead animals
Fun facts: The female will lay up to 180 eggs on a dead animal. When the larvae hatch from eggs, they help decompose the dead animal by eating it. The larvae are **detritivores** because they eat decaying meat.

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Pre- and Post-Visit Activities

*All books marked with an asterisk are available through the San Diego Public Library.

English-Language Arts

Organism Investigation

Review the organism descriptions provided in this packet with your class. If students have not yet experienced the program, they will be learning about these organisms at Cabrillo National Monument. If they have gone through the program, use the organism descriptions as a reminder of what they learned. Have students follow the format of the organisms descriptions to help with this activity. Use the resources in your school or town library or on the Internet and have students find books or websites about an animal or plant they wish to better understand. Here is a list of some native animals and plants that live in different parts of San Diego so students can better appreciate what may be in their own backyards:

Mammals – desert cottontail rabbit, mountain lion, bobcat, pocket gopher, leafnose bat, mule deer, coyote
Birds – roadrunner, turkey vulture, American kestrel, raven, scrub jay, California quail, western screech owl, Anna's hummingbird
Invertebrates – harvester ant, scorpion, quino checkerspot butterfly, black widow spider, jumping spider, earthworm, tarantula
Plants – laurel sumac, black sage, Torrey pine, California spineflower, short-leaved dudleya, Shaw's agave
Reptiles and amphibians – horned lizard, king snake, California treefrog, western pond turtle, pacific slender salamander

Try to answer the following questions about the organism you choose:
What is its scientific name?
What is its name in other languages?
Is it a producer, consumer or decomposer?
What does it eat?
What are some fun facts about it?

Books About Nature

The following books are great resources to explain important topics. Use them as a class, or have them available for students to read independently.
*The Magic School Bus Hops Home; a book about animal habitats by Joanna Cole
*The Magic School Bus Gets Eaten; a book about food chains by Joanna Cole
*Adaptation by Jeanne Bendick
*Animal Defenses; how animals protect themselves by Etta Kaner
*Who Eats What; food chains and food webs by Patricia Lauber
*What Do Animals See, Hear, Smell and Feel? by Ranger Rick Books

Mathematics

Word Problems

Use the word problems that are suitable for the grade level of your students, or change them as needed.

1. Hundreds of migrating birds pass by Cabrillo National Monument each winter to fly south to warmer areas. If birds migrate through Cabrillo National Monument in November, December and January, how many months per year are the birds not migrating?
2. There are many insect species at Cabrillo National Monument, and they all have the same number of legs. How many legs does each one have? Divide 36 by 6 to find the answer.
3. How many inches long can a striped racer grow? Multiply 5 times 10 to get the answer.
4. When a western fence lizard is attacked, it can lose its tail to distract the predator. If it takes one month for a new tail to grow ½ inch, how many months does it take for the tail to grow 2 inches?
5. Adult California ground squirrels can have one litter of young per year. To find out how many baby squirrels are in each litter, add 3 and 5.
6. If one prickly pear cactus pad has 40 thorns, how many thorns are on a cactus that has six pads?
7. Trapdoor spiders are quite strong, and can move up to 140 times their own body weight. If a trapdoor spider weighs 30 grams, how many grams can it move?
8. Red-tailed hawks can reach up to 40 miles per hour while flying. But they can go even faster while diving through the air for their prey. To find out how many miles per hour red-tailed hawks can dive, divide 360 by 3.

Science

Schoolyard Discovery

Suggested reading: *One Small Square: Backyard by Donald M. Silver

Background information:
The book, One Small Square: Backyard, gives wonderful step-by-step instructions on how to explore a small section of your backyard. To make this a school project, consider roping off a small square of ground in your schoolyard (approx. 1 ½ ft. x 1 ½ ft.). Read through the book for good project ideas and examples of observing, and share the book with your students. Depending on your grade level and daily schedule, create a schedule that best fits your class. Ideally, each student should visit the square more than once. Also, the square should be observed at different times of day, and in different seasons.

Materials:
One notebook
Pencil
Four stakes or rulers
String or twine
2 Magnifying glass

Preparation:
Choose an area that is near a bush or tree for a greater variety of organisms. Use small wood stakes or rulers to mark the four corners of the square, and wrap string or twine around the stakes or rulers to define the edges of the square. On the front of the notebook, write Our Schoolyard Square Notebook. Organize your class into pairs, or "observation buddies".

Instructions:
Explain to the class that they will have the opportunity to closely study a square of the schoolyard over time. Show the students where the square is located, or allow them to choose a spot together. Introduce students to the notebook, and explain that they will be writing in the notebook each time they make observations about the square. Remind students to write their name, the date and the time of day at the top of each page in the notebook, just like a scientist does. Demonstrate how to use a magnifying glass, and allow them to become familiar with using it. Talk to your class about using their senses while they observe: sight, sound, smell, touch, (not safe to use taste).

Allow students to visit the square in pairs for at least 5 minutes at a time. Encourage them to observe the square from different perspectives, i.e. sitting, standing, next to the square, farther away from the square. Depending on your class needs and abilities, you can give the students specific instructions each time, i.e. draw one organism you see in the square, use five adjectives to describe the ground in the square, or allow the students to write or draw as they choose. Give the students examples of good notebook entries by writing one yourself or coming up with a few entries as a class.

Use observations from the notebook as a stepping-stone to discussions. Here are some examples of discussion questions.
Why is it important to record date and time in a science notebook?
How have the observations changed depending on the time of day, or time of year?
What is the smallest organism the class has observed?
What is the largest?
Have you found evidence that an animal has visited the square even though you may not have seen it?
Are most birds seen in the morning, or afternoon?
How can we find more information about some of the organisms we have observed?
What do you think lives underground in our square?

Ant Communication

Suggested reading: *What Do Animals See, Hear, Smell and Feel? by Ranger Rick Books, *Discovering Ants by Christopher O'Toole, *Journey to the Ants by Bert Hölldobler and Edward O. Wilson,

Background information:
Ants are insects that do not communicate through speaking like we do. Instead, ants rely on pheromones (pronounced **fair**-o-moans), which are special chemicals that they produce and release from glands, or openings, in their bodies for communication. If you have ever seen a trail of ants outside, or maybe in your house, you can see that they know to follow each other in a perfect line. This is due to the pheromones that the first ant rubbed on the ground with her body as she was walking. The other ants use their antennae to feel for the pheromones and decide what they mean. Pheromones can have different meanings, such as, "Hi, I am a friend," "Enemy approaching," or, "Food is over here." Ants from the same colony all share the same pheromones, so they can tell if an ant is from their colony or from another colony. Ants from different colonies usually fight when they meet, just like many other animals defend their territories. This activity will help students understand how well and how quickly ants communicate using pheromones.

Materials:
One small plastic Ziploc bag for each student
One small brown paper bag for each student
Slices of lemon and onion
Potting soil
Coffee beans
Nutmeg (or another spice that has a distinctive odor, such as curry, or mint)
Stopwatch, or clock with a second hand

Preparation:
In each small plastic Ziploc bag, put one item that has a strong scent (lemon slice, onion slice, scoop of coffee beans, soil, nutmeg). Equal numbers of bags should contain the same item. For example, if the class size is 30 students, six bags should have lemon, six should have onion, six should have coffee, six soil and six nutmeg. Seal each bag shut, and place each one inside a paper bag to hide the item.

Instructions:
Explain to students how ants communicate using the books listed above or the information paragraph provided. Hand out paper bags to students and instruct them to NOT look inside. Tell the class that they will pretend to be ants and will work together to divide themselves into their correct colonies. Since humans don't have antennae to smell pheromones, the students will use their noses to smell their own scents and the scents of others. Ask the students to reach into their paper bags and open the Ziploc bag inside without looking at it. Then tell students to smell their scented items. This item will be the scent of his or her colony. Next, ask the students to walk around the room, smelling

others' items. When a student finds another ant that smells the same, the students should stay together in a group and walk around, smelling for other group members. By the end of the activity, ants that have the same scent should be in a small group with others that smell the same. It is not important to correctly identify the scented item, but the teacher can ask students to guess what their item is. Have the students take out their Ziploc bags and check if they ended up in the correct group.

Once students are familiar with the items and the activity, close the Ziploc bags again, collect them and redistribute them. Tell the students that ants are able to smell each other very quickly and decide if an unknown ant is from their colony or not. Let the class know that you will time them to see how quickly they can get into their colony groups. Start the stopwatch when you ask students to open their Ziploc bags, and stop the clock when all groups have been formed. For an even greater challenge, do the activity again and tell students they are not allowed to talk. They may only smell and use gestures to communicate.

Discussion:
What did you enjoy about this activity?
What difficulties did you encounter?
Was the activity more difficult when you were not allowed to talk? Why?
What are some advantages and disadvantages to using smell and pheromones to communicate?
Did this activity help you understand how ants communicate?

Visual and Performing Arts

Cabrillo Food Web Song

Sing to the tune of "The wheels on the bus go 'round and 'round."
For melody, listen to the "We sing in the car" audiocassette or CD by Pamela Conn Beall and Susan Hagen Nipp.
After students learn the words to this song, have them create movements to accompany each animal or plant as they sing the name, for example the red-tailed hawk movement could have arms spread like soaring wings, and the Jerusalem cricket movement could have hands digging through the air just like the Jerusalem cricket uses its front legs to dig through soil.

Verse 1: Let's sing about a food web, food web, food web.
Let's sing about a food web, to see what we can learn.

Verse 2: Plants are the producers, producers, producers.
Plants use water, soil and sun, to grow into food.

Verse 3: What are some producers, producers, producers?
Lemonadeberry and prickly pear cactus, California sagebrush and lichens.

Verse 4: Animals are consumers, consumers, consumers.
Animals will eat the plants, and some eat other animals.

Verse 5: What are some consumers, consumers, consumers?
Red-tailed hawk and trapdoor spider, and California ground squirrel.

Verse 6: California towhee and solitary bee, western fence lizard and cactus mouse.
Striped racer and western bat, they are all consumers!

Verse 7: All plants and animals have to die, but what happens when they die?
Decomposers eat them up, and recycle the food.

Verse 8: What are some decomposers, decomposers, decomposers?
Jerusalem cricket and darkling beetle, bacteria and fungi.

Verse 9: Now you've learned a food web, food web, food web.
Producers, consumers and decomposers, pass the food around.